THE JOURNAL FOR LIGHTWAVE 3D ANIMATORS

LIGHTWAVE™ PRO

an AMG Media, Inc. journal

Volume 4 Issue Number 3 • March 1996 • $8.00

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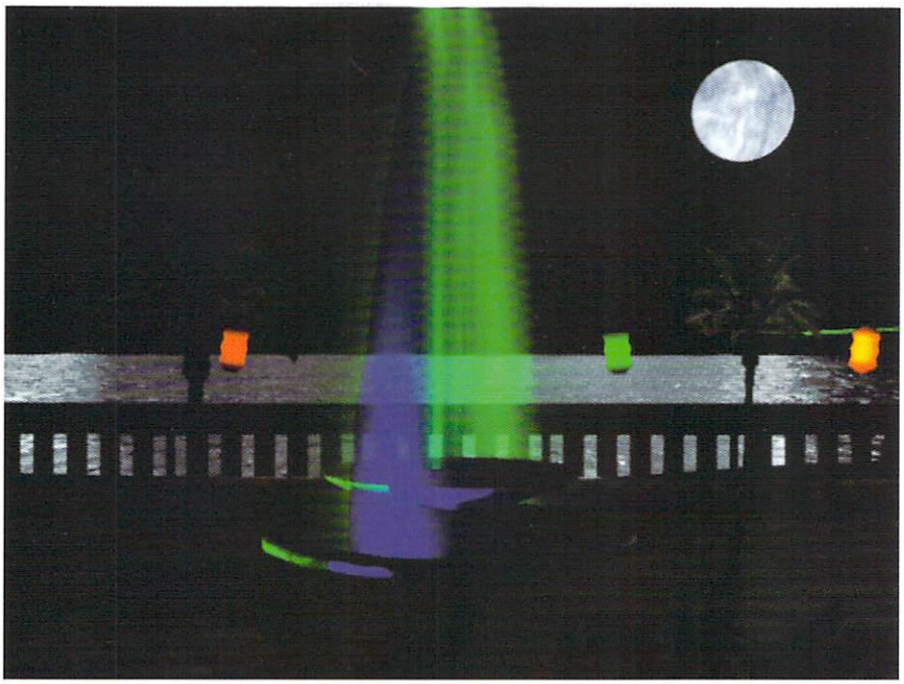

Fountain
An example of clip mapped trees casting shadows on a 3D scene.
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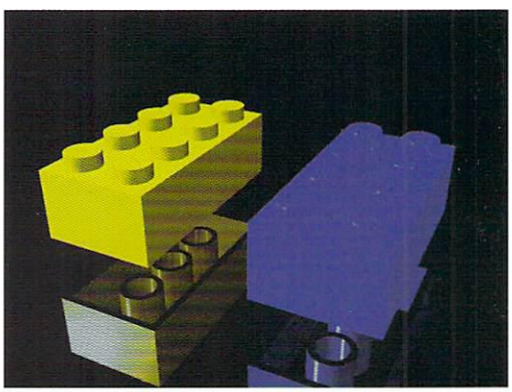

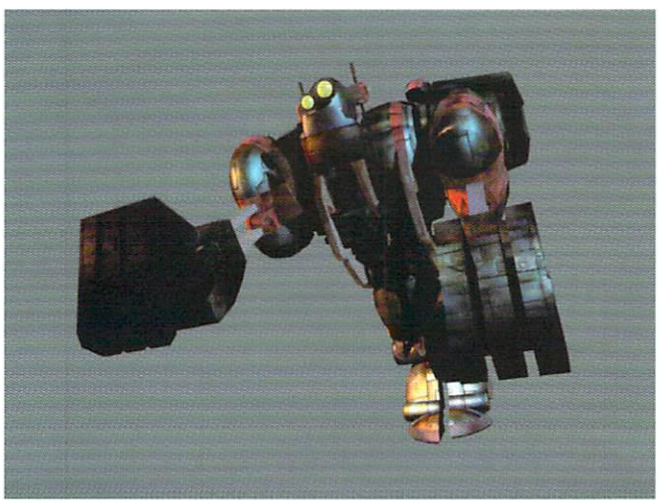

Up, Up and Away
The ApeBot from the LightWave CD-ROM (frame 50) (aber_52lws.) gets the "cel-look" in "3D to 2D," on page 14.
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EDITOR'S MESSAGE

by John Gross

Time flies like an arrow. Here we are wrapping up another NAB. I'm writing this message a few days before NAB, so I can't talk about what I haven't seen yet—with one exception—LightWave. NewTek came through (or at least, will in a few days) and surprised a lot of folks by announcing a new shipping version of LightWave. LightWave 5.0 (Intel and Alpha versions) will start shipping on Tuesday, April 16th. The manuals and CD's are being duplicated while I am writing this and should be set to go for NAB. While NewTek won't be selling it in their booth, they will have a no-cost, direct sales line available for orders. LightWave 5.0 will sell for $1,495.00 for Intel, Alpha, MIPS and Amiga version s (SGI version price to be announced). Upgrades for existing Intel, Alpha and MIPS version customers will be $495.00. Upgrade prices and ship dates for SGI and Amiga versions will be announced at a later date (I would expect sometime in May-June).

So, what's in LightWave 5.0? A lot. Both Modeler and Layout have OpenGL support for real-time shaded object redraw and background image generation. Windows95 and NT support OpenGL in software, but if you have an OpenGL accelerator card, you can expect to dramatically increase your performance. Because Modeler has the ability to show color shaded objects, it became necessary to implement some way of changing/creating simple surface adjustments (color, smoothness, Specularity, etc) directly in Modeler. That, combined with the re-vamped Import/Export features make Modeler and Layout more integrated.

Perhaps one of the coolest new features in Modeler is the addition of MetaNurbs. Like Metaform did, MetaNurbs takes polygonal based modeling one step further. Imagine being able to take a metaformed object and move it's points around to modify the shape of the metaform. When you model with MetaNurbs, you are modifying the "cage" around a metaformed-like object by simply dragging control vertices that are formed at the junctions of the original

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LIGHTWAVEPRO
an AMG Media, Inc. Journal

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LIGHTWAVEPRO (Vol. 4, No. 3); (ISSN 1076-7819) is published monthly by AMG Media, Inc., 1308 Orleans Drive, Sunnyvale, CA 94089. A one-year subscription (12 issues) in the U.S. and its possessions is $48 (U.S.); Canada/Mexico, $60 (U.S.); overseas, $84 (U.S.). To subscribe, call toll-free 1-800-322-2843. Allow 4 to 6 weeks for first issue to arrive. Second-class postage rate paid at Sunnyvale, CA and additional mailing offices. POSTMASTER: Send address changes to *LIGHTWAVEPRO*, 1308 Orleans Drive, Sunnyvale, CA 94089.

About this month's cover: This image was created by Bruce Branit and is part of an animation which synchronizes the pilot's arm movements with those of the vehicle. Both sets of arms, human and mechanical, are IK chains. The frosty glass effect was created using specular and bump maps created in Adobe Photoshop. Bruce is head of animation for FryeAllen in Topeka, KS.

Model Shop

The Building Blocks of Modeler

by Kyle A. Thatch

If you read (and remember) the September 1995 issue of *LIGHTWAVEPRO*, you will remember that I covered six steps for creating successful objects. The six steps are:

1) Geometric Construction
2) Pre-Planning
3) Construction
4) Measurement
5) Tools and Techniques
6) Function

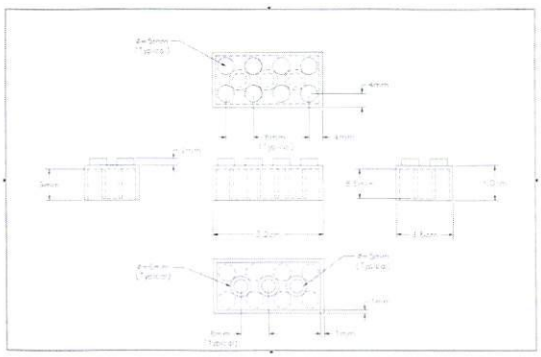

Figure 1

All of the steps listed above were used in the following tutorial except Function—you will see later that Function does not play a vital role with this simple object. What is the object we are going to model? How about a child's building block? Building blocks are one of the simplest objects I know of that can both teach novices and challenge experts alike. We will use two primitives and very few tools to build this simple object, and if you're not careful, you might learn a few tricks.

If you find this lesson too easy or have problems that you would like to have addressed in this column, speak up. I will provide all the information at the end of this column to contact me. It is imperative that I be made aware of what you need help with concerning Modeler.

To begin this tutorial, start Modeler and hit (o) for Options and set polygons to One-sided and Quadrangles, curve divisions to Course and Undo Levels to 15 (4.0 users only). Next press (d) for Display and set Unit System to Metric.

The Basic Block

Two of the six steps, Pre-Planning and Measurement, are derived from Figure 1, the step of Geometric Construction is the Block itself. We will start by making the basic block shape. From the Objects Menu pick Box and (n) for Numeric enter the following:

Low
X= -1.6 cm m
Y= -5 mm
Z= -8 mm
High
X= 1.6 cm
Y= 5 mm
Z= 8 mm
Segments
X= 1
Y= 1
Z= 1

Remember to hit enter to make the box once you close the numeric requester. "OK," you say "I did what you said but I can't see anything." Hit (a) to Auto Fit, and there it is, a simple block. Use the space bar to toggle to Polygon Mode at the bottom of the screen. Now, Lasso only the bottom of the block (Figure 2) and hit (b) for Bevel, input 1 mm for the Inset and 0 for Shift. Repeat the Bevel process again, only this time input 0 for Inset and -9 mm for Shift. We have just placed a hole in the bottom of the block without using a Boolean operator. It takes less time to use the Bevel tool, so try to use it whenever possible for making holes or even latheing objects.

To complete the block, click in a blank area of the far left side of the screen and Lasso around the bottom of

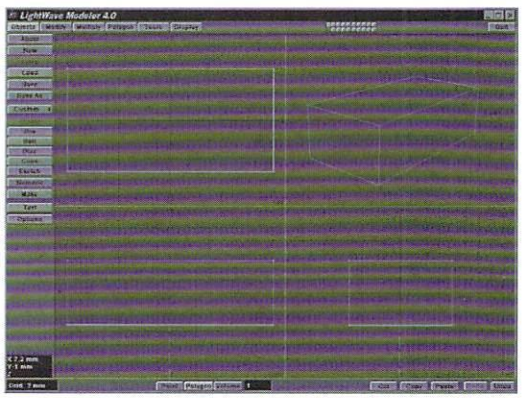

Figure 2

the block. Notice that there are four polygons (Figure 3). Wouldn't it be better if there was only one? Go to the Polygon Menu and select Merge. There you go—one polygon, now all you need to do is name the surfaces of the block. Press (q) for Surface, enter "Block-Flat" and this will name all the surfaces flat.

One Peg or Eight?

Looking at Figure 1, you see that the pegs on top of the block are 4 mm from the sides of the

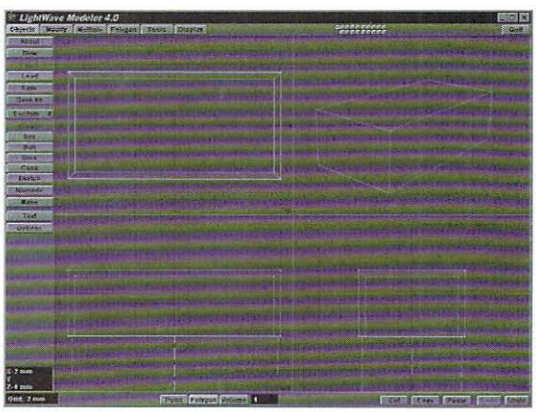

Figure 3

block, especially the pegs in the corners. Use the space bar to toggle to Points Mode at the bottom of the screen and select only the bottom right point on top of the block. Now hit (c) for Copy, (2) for Layer 2, then (v) for Paste. We are going to use this point as a guide for placing the pegs on top of the block. So you can see what you are doing, hold down the (Alt) key and press 1. This puts layer 1 in the background and keeps layer 2 in the working area of Modeler.

Select (t) for Move and enter the following Numeric numbers:

X= 4 mm
Y= 0
Z= 4 mm

You should now understand what the point is for. Select the point, then hit (i) for info and make a note of the X, Y and Z coordinates. They should be X= -1.2 cm, Y= 5 mm, Z= -4 mm. With the point still selected press (z) for Delete to remove it from the workspace.

To make the peg, go to the Object Menu and select Disk, then (n) for Numeric and enter the following:

Sides=	32
Axis=	Y
Segments=	1
Center	
X=	1.2cm
Y=	5mm
Z=	-4mm
Bottom=	5mm
Radii	
X, Y, Z=	2.5mm
Top=	7mm

Don't forget to hit enter to make the disk. Select the bottom of the disk and hit (z) for Delete, and this polygon will not be seen. Now select the top of the peg by hitting (q) for Surface, select "Block-Flat" from the surface window and choose apply to close the requester. Press (Shift ") to Invert Selection and name (q) these polygons "Block-Smooth". How do you add the other seven pegs? Simple, use the Clone and Mirror commands in that order.

Pick the Multiply Menu, then Clone. When the requester appears, enter 3 for the number of clones and 8 mm for the X offset value. You should have four pegs in a row evenly spaced (Figure 4). Still in the Multiply Menu, select Mirror and (n) for Numeric. The axis should be Z and Position is 0 hit enter. You have now completed the pegs for the top of the block. Finish by cutting and pasting the pegs to layer 1. Simply hit (x) for Cut, (1) for Layer 1 and finally (v) to Paste the pegs to layer one.

Just Because You Can't See It...

Let's finish our building block by making the tubes in the bottom of the block. Go back to layer two (2), select the Object Menu and Disk (n) for Numeric, then enter the following:

Sides=	32
Axis=	Y
Segments=	1
Center	
X=	-8mm,
Y, Z=	0
Bottom=	-4.5 mm
Radii	
X, Y, Z=	3.25 mm
Top=	4 mm

Hit enter to make the disk. Lasso the top of the Cylinder and delete (z) the polygon. Select the bottom of the disk and press (b) for Bevel enter 0.9 mm for Inset and 0 for Shift. Bevel again. This time, use 0 for Inset and -8.5 mm for Shift. Delete (z) the polygon which is still selected. Select the bottom of the tube and name (q) the surface "Block-Flat". From the surface window, press apply. Now invert your selection (Shift ") and name (q) these surfaces "Block-Smooth" from the surface window.

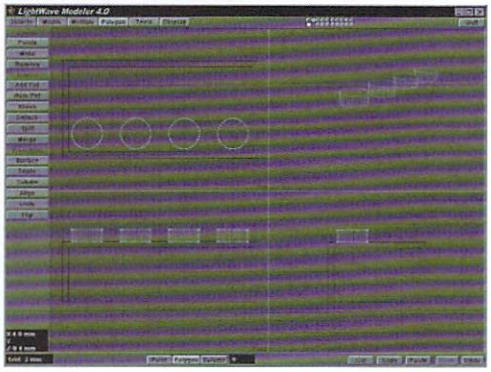
Figure 4

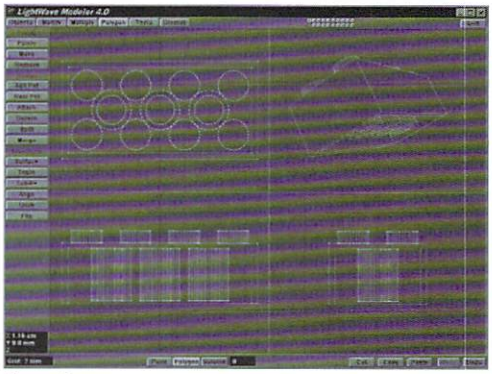
Figure 5

Once again, use the clone command to add the other tubes to our Building Block. Select the Multiply Menu, then Clone input 2 for number of clones and 8 mm for x offset. Press (OK) to perform the clone. All that is left to do is to cut the tubes back to layer one. After doing so, press (Shift S) for Save As and name your finished Object "Building Block.lwo" (Figure 5).

Looking at the color image of the two building blocks, you may see a slight difference in the one on the right, that is because a small amount of filleting was added to its top pegs. If you wish to see how I did this, contact my Web Page at www.win.net/sdiinc/. I hope that novice users can get a feel for how to use simple tools in modeler to create objects they can find readily around them, which by the way, is a good place to start using Modeler. Expert users may find a few different ways to approach object design and construction. Most importantly, I hope all users will measure objects they are constructing for scale to use them with other objects for animation. Until next month, good luck and keep modeling.

LWP

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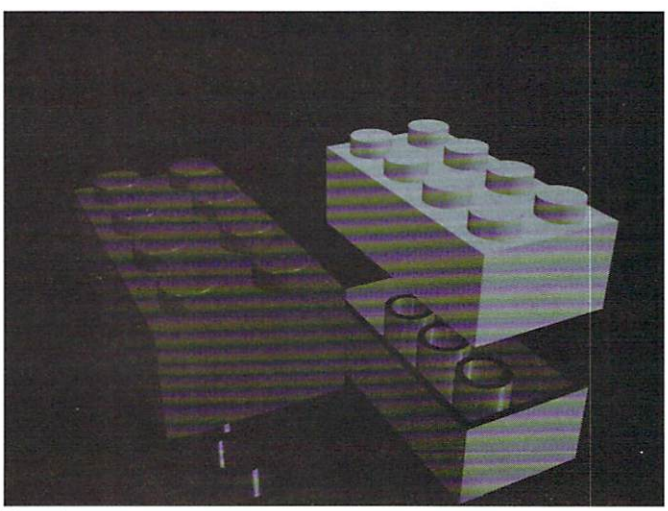
Figure 6

Plant a 2D Tree

2D Tree Landscapes for LightWave 3D

by Dan Bloomfield

I do not think I shall ever see, anything as lovely as a tree. A famous poem and true enough, but I doubt the author had 3D animation in mind. Nevertheless, how many times have you seen computer animations where the horizon is bleak and featureless? Pretty boring. If you want to create interesting landscapes complete with trees, flowers and shrubs, how can it be done? True, you could create an animation in a program like World Construction Set or World Builder, and composite your 3D objects over that moving background. Those programs do an amazing job and the landscapes can look very nice indeed, but what about the trees casting shadows on your objects, or the objects casting shadows on the trees? What if you want landscape in the foreground as well as the background? It can become an impossible chore.

Well, what about using 3D trees? The original Toaster software came with a nice one, but did you look at the poly count? A whole forest of those will quickly deplete even the most RAM generous system. With the clip mapping feature in LightWave 3D, you can build an entire forest with just a few image maps and some very low polygon count objects

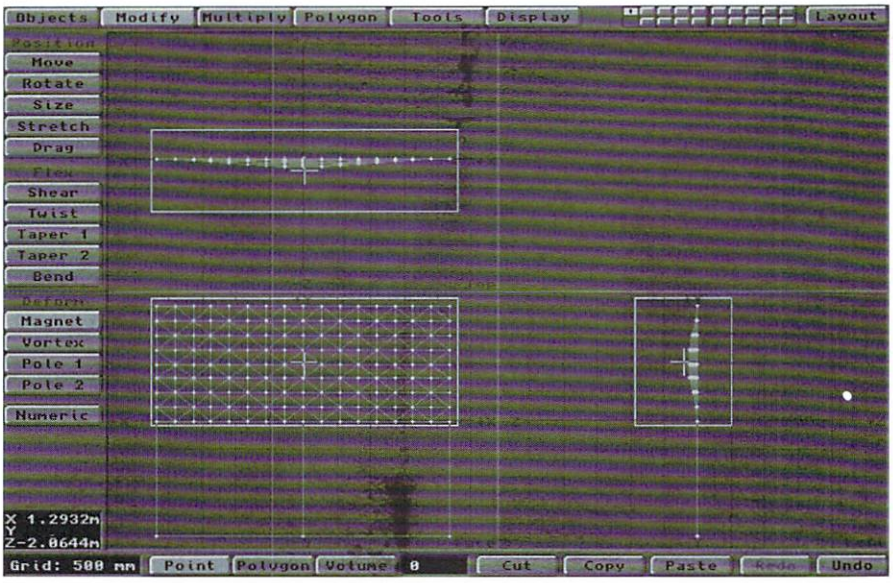

Figure 1: Use the Magnet tool after subdividing and tripling polygons.

Faking It

Clip mapping is a technique whereby white areas of bitmap images (or black if you use a negative image) are cut or clipped from an object when it is rendered. You don't see any sign of it in the wireframe view in Layout, it only shows up when the object is rendered. By use of a complex bitmap, you can fake an extremely complex object like a tree with only a simple one polygon plane. When used in conjunction with raytraced shadows, only the part of the object that is not clipped casts shadows, so you can even have a leafy shadow pattern cast! Unfortunately, this will not work with shadow maps. They will only cast a shadow of the entire plane object, so they should be avoided when using this procedure.

To start, you will need three versions of the same tree image, all exactly the same size. You need a color image (preferably 24 bit) for your color map, a gray scale version for use as a bump map, and a black and white version as your clip map. Where do you get these images? Well, you could make your own from a scanned photo or video, but expect to take some time cutting the tree out from the background. After you have cropped the image and eliminated the background around the tree, you should save the image as your color map. Now using whatever image processing program you happen to own, make a gray scale version of the same image and save that as your bump map. Here's the hard part: Using the capabilities of whatever package you have, replace the gray colors of the tree with pure black (or white, it doesn't matter as long as the background is the opposite). Now, fill in all the spaces between leaves with the background color, otherwise the background of the original color map will show between the leaves and not your 3D scene. When all the areas that you want clipped from the plane object are the background color, save the image as your clip map.

Whew! That was a lot of work! Fortunately there are commercial collections of exactly these kinds of images such as those found on the Blocks and Materials CD-ROM from KETIV Technologies. You may be able to find others from other CD-ROM publishers. Using pre-made images can save a lot of time. I've included sample images on this month's *LIGHTWAVEPRO* disc that will give you an idea of how to proceed.

Making a Tree

Now that you have the images, you can go to Modeler and make your tree polygon. In the Display panel, click the BG Images button and load one of your tree images. Have the image displayed on the z axis, and be sure to compensate for the aspect ratio of the image when you set the size of the image display. For example, if your tree image was 150 pixels wide but 300 pixels tall, you would want to make your y axis size twice the x axis to preserve the true shape of the image. You should also size the image in Modeler appropriately for the size of the tree in your scene (you don't see too many 1 meter tall trees unless you visit a bonsai garden).

Once you have the correct image size, go to the Objects panel, select the box tool and drag out a box the size of the image in the face view. Hit the enter key to make your box, that should have a

depth of zero on the z axis. It's just a flat plane with the normal facing into the negative z axis. If there is any possibility of seeing your tree from the back side, take a moment to copy the polygon (c), flip the normal the other way (f) and paste the original back in place (v). Don't forget to merge points (m). Now you have a two-sided polygon visible from both sides. Give it a surface name like flat_tree (q) and save it out.

Loading the flat plane object into layout, you can load the three images you have created and assign them to your flat_tree surface. Open the surface panel and hit the (t) button alongside surface color. Planar image map the color map on the z axis and hit automatic sizing. Do the same thing for the bump map, except use the gray scale version of the image. Bump maps default to 50%, but you should do several test renders at different values to see which one works best for this particular image/object combo. Good results can be obtained by also using the gray scale image as a diffuse texture. If the object renders too dark using a diffuse map, you can take the image back to your image processor and lighten it up, saving it with a different name and use that as your diffuse map. For the last step, leave the surface panel and open the object panel. Hit the (t) button alongside clip map, and assign the black and white image as a clip map on the z axis and auto size.

Although the object still looks like a flat plane in the wireframe view, it will render as a tree with all areas that are white in the clip map image being clipped from the object (unless you turn on negative image, then all black areas will be clipped). If you test render and see a thin outline of the color map background around your object, adjust the texture size of your clip map making it slightly smaller on the x and y axis, as needed to trim away the edges of the color map. At this point, be sure to save both the object and the scene, because clip maps are not saved with the object file. They're saved with the scene file.

Trees Should Have a Goal Too

If you've done everything correctly up to this point, you should have a one polygon object that will render as a complex tree (the same technique works for shrubs and flowers too). But what if our camera moves around? It will quickly become apparent that the tree has no depth if viewed from a side angle. The simple solution is to not let the viewer see the tree from the side. By using 4.0's inverse kinematics, it is relatively simple to keep this from happening even with a moving camera.

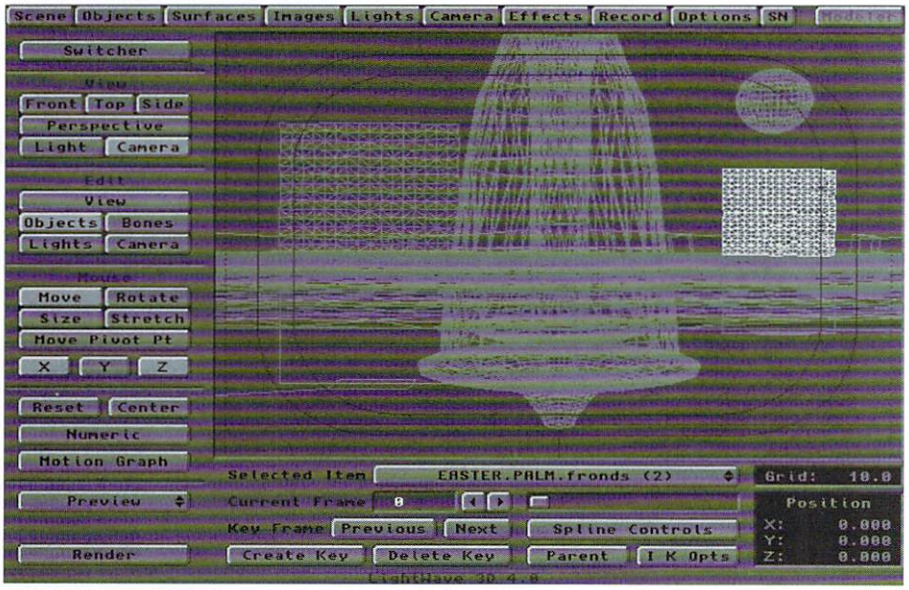

Figure 2: An example of clip mapped trees casting shadows on a 3D scene.

First open the Objects panel and hit Add Null Object (number pad +, if Objects are the selected Edit item). Parent this null object to the tree and give it a slight offset on the negative z axis (remember to set a key frame at zero). Now create a second null object and take a moment to rename the null objects so you don't get confused. In the Objects panel, hit Save Object and rename the first null as Tree Null. Name the second null as Goal Null. With the Tree Null selected, open the I K Opts panel (i). Select the Goal Null as the Goal Object of the Tree Null and close the panel.

Now select the Tree as the current object and make Rotation the mouse action item. Deselect pitch and bank, as this will constrain the tree from rotating around any axis except the y. In the layout window, move the Goal Null around. You should see the tree object follow the motion of the goal. Move the Goal behind the camera and set a key frame for it there, then hop back and forth between frames to clear any motion of the tree. Now any time you set a key frame for the camera in your scene, you should move the goal object behind the camera at the new position and set a key frame for the tree at that frame. Setting key frames for the goal object alone will not work, as objects will not follow their IK goals automatically in a scene. You must manually move the goal in the layout window and set a key frame for the objects in the IK chain. This works especially well with camera pans, because while the camera is rapidly panning no one will be able to notice that the trees are also turning. Shadow casting lights can also be rotated during camera pans. Avoid having shadows cast from the side of the tree, as these shadows will only be a thin line.

Blowin' In the Wind

You now have a simple flat tree object and scene, but there are a couple of other adjustments you can make to enhance the realism of your scene. Taking your flat polygon back into Modeler, subdivide your polygon to prepare it for displacement mapped wind. Going to the polygon menu, hit Subdivide (D) and select faceted. Now you have eight polygons instead of two (four on each side). Select the top four polygons and do three more subdivides. You should now have 256 polygons in the upper half of the object. Now you should triple those polygons (T) so that none of them become non-planar. Merge points again to get rid of the duplicate points. Finally, go to the Modify menu, and select the Magnet tool. With the left mouse button drag out a rectangle around our upper polygons in the face and left views, with the cursor centered on the upper half.

With the right mouse button, drag the cursor out just a little on the negative z axis from the left or top view. The polygons should have bowed out a little in the middle. If not, undo and try again. We don't want to overdo this, but just bowing the object out a little will enhance the feeling that this is a real 3D object and not just a flat plane.

Taking the object back into Layout, open the Object panel and give the tree a displacement map by hitting the (T) button alongside Displacement Map. Unlike bump maps, displacement maps actually distort the point geometry of the object. By using the ripple texture, you can make the "leaves" appear to be blowing in the breeze. The exact parameters of the displacement map will depend both on the object and the image map that you're using for your tree. In the sample image on the *LIGHTWAVEPRO* disc, branches run through the leaves. You don't want the branches to appear to be rippling, so you need to be careful and use falloff on the y axis so only the top of the tree is rippling. Since your tree object is 4 meters tall and was centered on the zero point in Modeler, you want to place the texture center at 2 on the y axis (the top of the tree). Using a texture size of .4, leave the wavelength and wave speed at the defaults. This needs to be a subtle effect. If it's overdone it will give itself away, so select a small texture amplitude of .0125. Again these values will change depending on the

see Tree, page 13

Let It Flow!

Learning Liquid Animation In the Sewer

by Greg Wilson

Creating an organic effect, as opposed to something that is or looks artificial, can be one of the trickiest techniques for a 3D modeler and animator. Not only is creating the effect a challenge, but so is designing a specific technique that can be used repeatedly for different situations. One organic effect that looks complicated at first is running liquid with random trails and drippings. This effect could be used for numerous situations: a waterfall, milk spilling over the edge of a table, water sheeting down a wall, or as in this tutorial, sewage flowing out of a pipe.

For this tutorial, I began designing a scene that would use water. Using the Transparency texture (Surfaces panel) on your object can dramatically slow down the rendering process. Couple that with Trace Refraction (Camera panel) and you'll be waiting a great deal longer for your scene to render. The effect can be worth the wait, but for the sake of making this tutorial, it's the movement of the liquid that's important, not the liquid itself. Besides, sewage is everywhere—let's have fun with it.

The Pit

Designing our sewer will be easy enough. For those of you just learning LightWave, I will outline everything I did step-by-step so we can produce the exact same scene. Before you begin, you should create two directories. Call both of them "Sewer" but place one in the Objects directory, and the other in the Scenes directory.

Our first object to create will be a box that represents the walls of the sewer, so go into Modeler, Select Box (Objects panel) and click the Numeric button (n). Enter these values:

Low
X= -61cm
Y= -1m
Z= -91cm
High
X= 61cm
Y= 1m
Z= 91cm
Segments
X= 1
Y= 1
Z= 1

- Click Make (Objects panel or Enter).
- Either select all the polygons on the box or leave them all unselected.
- Select Flip (Polygon panel or f).
- Highlight only the top polygon as shown in Figure 1.
- Select Surface (Polygon panel) and name it "PitGrid".
- Invert the highlighted selection (").
- Select Surface (Polygon panel) and give it the name "PitWalls".

You now have your sewer pit, but before you save it you must accomplish a few more steps.

From Whence The Stench Comes

It's time to design the tube the sewage will pour from.

- Go to layer 2.
- Select Disc (Objects panel), click the Numeric button (n) and enter these values:

Axis= Z
Sides= 32
Segments= 1
Bottom= 70cm
Top= 2m
Center
X= 0
Y= 40cm
Z= 1.35m
Radii
X= 18cm
Y= 18cm
Z= 65cm

- Click Make (Objects panel or Enter) to create the tube.

Next, use this tube to create a hole in

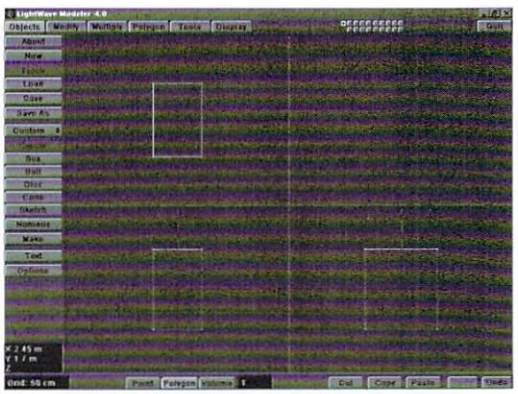

Figure 1: The box that will become our sewer.

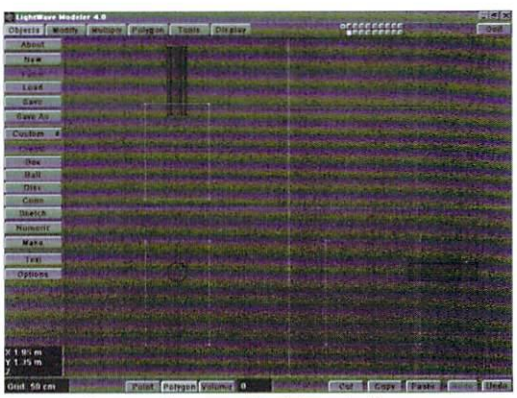

Figure 2: Using a tube to tunnel a hole in the box.

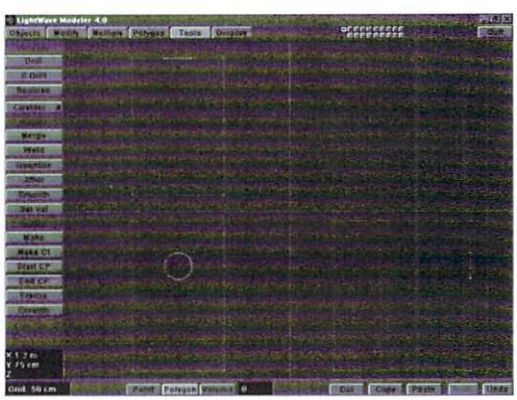

Figure 3: A hole has been made for the pipe to fit in.

the wall of the pit for a pipe to go through.

•Make layer 1 the active layer and layer 2 the background layer, as shown in Figure 2.
•Select S to Drill (Tools panel or C).
•Select Tunnel, and click OK.

You've cut a hole in the pit for the tube to go through, as shown in Figure 3. Now let's make a second tube. You need the second tube to cut a hole in what is a solid cylinder in layer 2.

•Go to layer 3.
•Select Disc (Objects panel), click the Numeric button (n) and enter these values:

Axis=	Z
Sides=	32
Segments=	1
Bottom=	68cm
Top=	1.99m
Center	
X=	0
Y=	40cm
Z=	1.335m
Radii	
X=	16cm
Y=	16cm
Z=	65.5cm

•Click Make (Objects panel or Enter) to create the second tube.
•Go to layer 2 and select layer 3 as background layer, shown in Figure 4.
•Select Boolean (Tools panel or B), then select Subtract and click OK. You can see the result in Figure 5.

Now you've made what looks like a tube. Notice we didn't create a hole in the back of the tube—this is so the camera won't see through the tube in Layout if positioned to do so. Let's go ahead and clean up a little, then finish our sewage pipe.

•Go to layer 3 and delete this object, just to tidy things up.
•Go back to layer 2 and only select the rear polygons towards the +Z axis of the view, as shown in Figure 6.
•Select Surface (Polygon panel) and apply the name "SewagePipeEnd".
•Invert the highlighted selection (").
•Select Surface (Polygon panel) and name the rest of the tube "SewagePipe".
•Select the entire object and click Cut (x).
•Go to layer 1 and click Paste (v). Figure 7 shows the finished object.
•Export your object to Layout, or select Save As (Object panel or S) and save the object as "Sewer.lwo".

Pouring It Out

Now let's create our slimy sewage! You'll need to think ahead about how to use metamorph to create the look you want for the sewage. Create one object for the surface to go on, then another object that the first object will be forced to take the shape of. If using metamorph is unclear to you, perform the "Advanced Tutorial #3" in the LightWave 3D User Guide. The rings are a good example.

•Go to layer 2.
•Select Box (Objects panel), click the Numeric button (n) and enter these values:

Low	
X=	-15.494cm
Y=	34cm
Z=	40cm
High	
X=	15.494cm
Y=	36cm
Z=	1.99m
Segments	
X=	15
Y=	4
Z=	80

•Click Make (Objects panel or Enter), (Figure 8).
•Click Triple (Polygon panel or T).
•Select Surface (Polygon panel) and enter the name "Slime".
•Export this object to Layout or select Save As (Objects panel or S) and save the object as "Slime.lwo".

This object will be used to apply the texture to the slime. Now you need to create the object's metamorph target. To do this, add some round edges and bend the object into the appropriate shape. You can either follow the lengthy series of steps listed below, or try your own technique to get a similar look.

•Drag open the Side view so only it is showing.
•Highlight the first 17 rows of polygons on the left of this view near the -Z axis as shown in Figure 9, and click Hide Uns (Display panel or =).
•Press the (/) key to deselect the highlighted polygons.
•Drag open the Face view so only it is showing.
•Press the (a) key.
•Select the points on each of the four corners, as shown in Figure 10.
•Drag open the Top view so only it is showing.
•Press the (a) key. Take a look at Figure 11 to get an idea of what we're doing.
•Select Stretch (Modify panel), click the Numeric button (n) and change only the X value

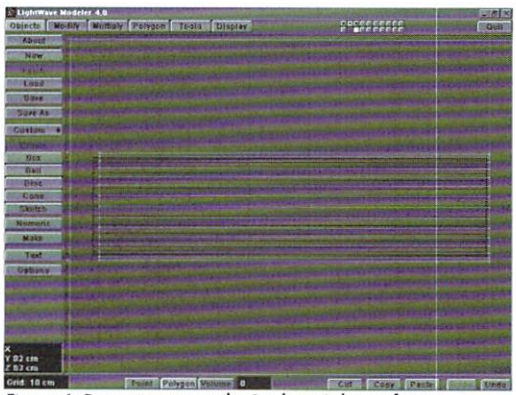
Figure 4: Preparing to use the Boolean Subtract function.

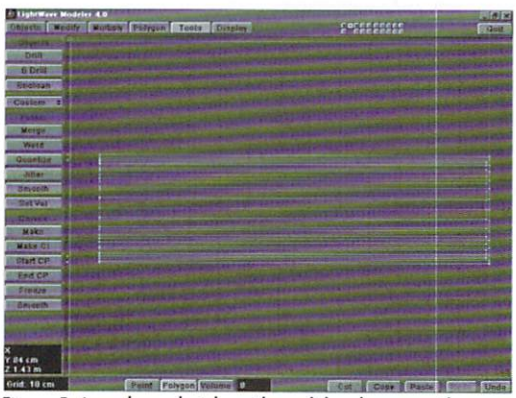
Figure 5: A newly made tube with a solid end on one side.

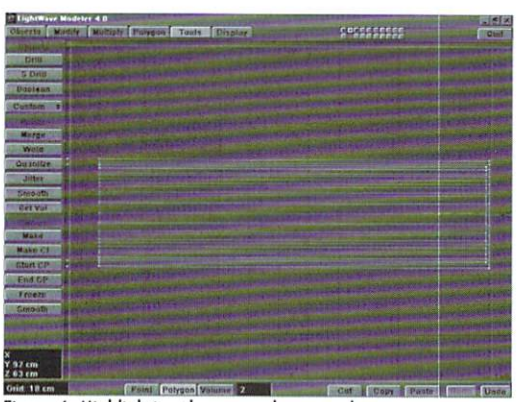
Figure 6: Highlighting the rear polygons only.

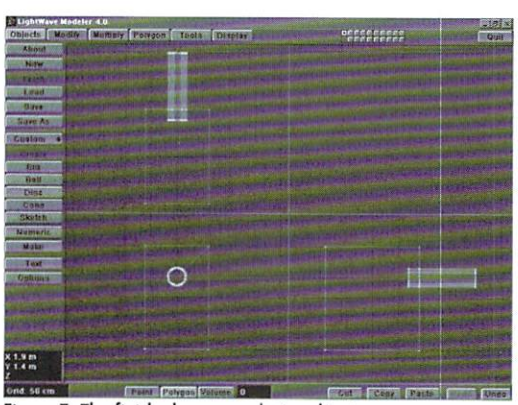
Figure 7: The finished sewer and pipe object.

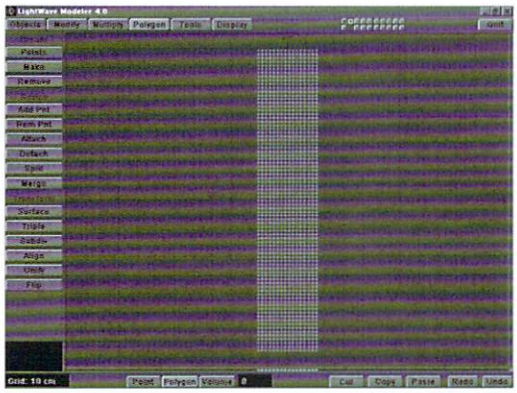

Figure 8: The object that our slime surface will be applied to.

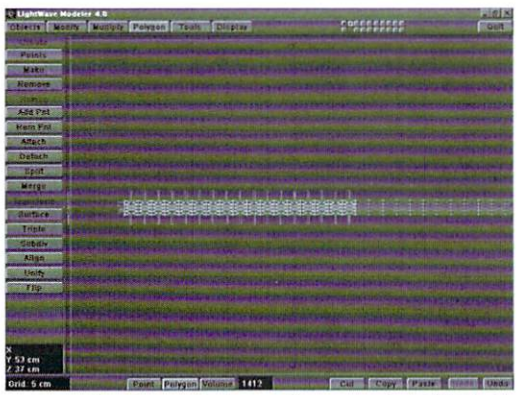

Figure 9: The 17 rows of polygons that need to be highlighted.

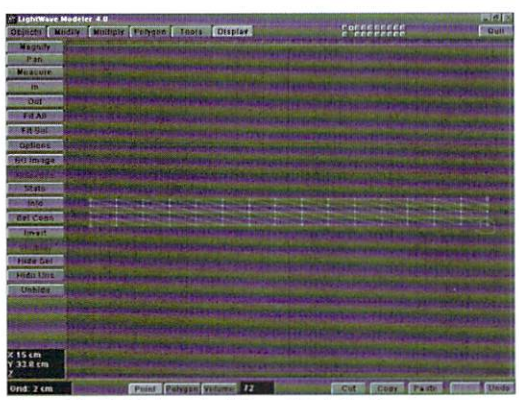

Figure 10: Highlight each of the points in the four corners.

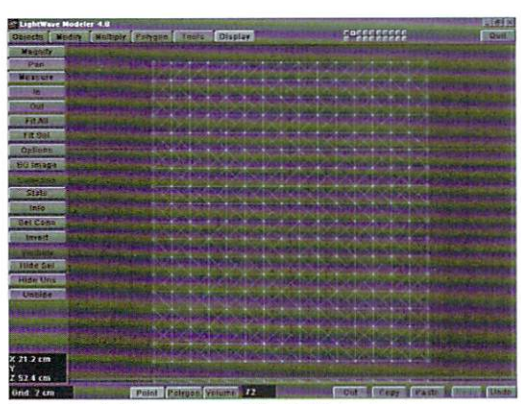

Figure 11: A different view of the highlighted points.

to .99. Click OK.

•Now deselect the top two highlighted points.

•Select Stretch (Modify panel), click the Numeric button (n) and change only the X value to .99. Click OK.

•Now deselect the top two highlighted points.

•Select Stretch (Modify panel), click the Numeric button (n) and change only the X value to .98. Click OK.

•Now deselect the top two highlighted points.

•Select Stretch (Modify panel), click the Numeric button (n) and change only the X value to .98. Click OK.

•Deselect all the points by pressing the (/) key.

•Drag open the Face view so only it is showing.

•Press the (a) key.

•You need to highlight four points again, two on the left and two on the right. You also need one down from the top and one up from the bottom from what was previously selected, as shown in Figure 12.

•Drag open the Top view so only it is showing (Figure 13).

•Press the (a) key.

•Now deselect the top two highlighted points.

•Select Stretch (Modify panel), click the Numeric button (n) and change only the X value to .99. Click OK.

•Now deselect the top two highlighted points.

•Select Stretch (Modify panel), click the Numeric button (n) and change only the X value to .99. Click OK.

•Now deselect the top two highlighted points.

•Select Stretch (Modify panel), click the Numeric button (n) and change only the X value to .99. Click OK.

•Go to polygon selection and highlight all the visible polygons (17 rows).

•Select Unhide (Display panel or \).

The slime should now be appropriately tapered for it's exit from the pipe. The next series of steps you need to perform in Modeler will bend a portion of the object into a 90 degree curve to create the pouring effect. This is easily accomplished by using the Bend tool (Modify panel) on selected polygons, but I will outline the "old fashioned" way below for those of you with really old versions of Modeler.

•Make sure you're in the Left view only and that the first 17 rows of polygons near the -Z axis are highlighted.

•Select Rotate (Modify panel or y), click the Numeric button (n) and enter the following:

Axis	X
Angle	15
Center	
X=	0
Y=	35cm
Z=	73.8cm

•On the right side of this view, deselect row 17 only.

•Select Rotate (Modify panel or y), click the Numeric button (n) and enter the following:

Axis	X
Angle	20
Center	
X=	0
Y=	34.5cm
Z=	71.85cm

•On the right side of this view, deselect row 16 only.

•Select Rotate (Modify panel or y), click the Numeric button (n) and enter the following:

Axis	X
Angle	25
Center	
X=	0
Y=	33.35cm
Z=	70.25cm

•On the right side of this view, deselect row 15 only.

•Select Rotate (Modify panel or y), click the Numeric button (n) and enter the following:

Axis	X
Angle	30
Center	
X=	0
Y=	31.6cm
Z=	69.25cm

•Deselect the highlighted polygons by pressing the (/) key.

The liquid should now curve (Figure 14) into a right angle from it's original position. Go ahead and lengthen the 14 rows of polygons that are hanging down from the rest. Starting from the top, gradually make the spaces within the polygons greater than the row above to create the impression that the slime is accelerating as it falls. To do this, use the Magnet (Modify panel) to pull the polygons downward. Center the magnet a good distance below the polygons and make the magnet extremely wide on the X axis, then make the magnet wider than the polygons, according to the Left view. Pull the magnet downward dragging the polygons. You can try this on your own, or use the steps given below.

•Select Magnet (Modify panel), click the Numeric button (n) and enter the following values:

Axis X
Radius
X= 0
Y= 81.3cm
Z= 30cm
Center
X= 0
Y= -49.7cm
Z= 69.2cm
Offset
X= 0
Y= -1.45m
Z= 0

•Click Apply (Modify panel or Enter) and you'll see that the downward traveling polygons have been lengthened, as represented in Figure 15.
•Export this object to Layout or click Save As (Objects panel or S) and save this object as "SlimeTRGT.lwo".

Leave Modeler and go into Layout where you'll set up the scene and give your objects the necessary details.

•Select Load Object (Objects panel) and load the object "Sewer.lwo" located in the "Sewer" directory.
•Repeat the loading process for the objects "Slime.lwo" and "SlimeTRGT.lwo".
•Because the object "SlimeTRGT.lwo" was the last one loaded, it should be listed as the Current Object (Objects panel). Under Object Dissolve, change it from 0 to 100 percent so this object won't be visible in the scene.
•Switch the Current Object (Objects panel) to "Slime.lwo".
•Enter 100 percent as the Metamorph Amount (Objects panel).
•Switch the Metamorph Target (Objects panel) to "SlimeTRGT.lwo".

Now the flat version of the sewage will be forced into the shape of the tapered and curved version. To give your sewage the dripping and streaming look, use the Clip Map on the Objects panel to cut out certain areas. Use a Clip Map instead of a Transparency Map to help speed up rendering time. You can also add a Texture Falloff rate that will allow only the areas beyond the pipe to be cut out. Just remember that you'll be applying all the surface attributes to the object "Slime.lwo" because "SlimeTRGT.lwo" will be invisible to the camera.

•Click the T button beside the Clip Map (Objects panel), select Fractal Noise as our Texture Type, then enter the following:

Texture Size
X= 0.02
Y= 0.0001
Z= 0.08
Texture Falloff
X= 0
Y= 0
Z= 295
Texture Center
X= 0
Y= 0
Z= 0.4
Texture Pattern Velocity
X= 0
Y= 0
Z=- 0.015
Texture Value=150

•Select Use Texture (Clip Map panel).

Now your sewage looks like it's dripping and streaming, so it's time to add a little color to your object by going into the Surfaces panel.

•Select Slime as our Current Surface (Surfaces panel).
•Select Surface Color (Surfaces panel), enter the following values:
Surface Color
Red= 43
Green= 108
Blue= 0

•Select the T (Texture Map) button beside Surface Color (Surfaces panel) and put Fractal Noise as your Texture Type, then enter the following:
Texture Size
X= 0.01
Y= 0.01
Z= 0.03
Texture Velocity
X= 0
Y= 0
Z= -0.015
Texture Color
Red= 54
Green= 56
Blue= 46
Contrast= 0.6.

•Select Use Texture (Color Texture panel).
•In the Surfaces Panel, enter these values:
Diffuse Level= 90%
Specular Level= 75%
Glossiness= High

•Turn Smoothing on.
•Turn Double Sided on.

Your sewage is complete and you should now apply surface values to the"Sewer.lwo" object.

•Select PitGrid as the Current Surface (Surfaces Panel) and under Transparency Value enter 100.
•Select the T (Texture Map) button beside Transparency Value (Surfaces panel), select Grid as our Texture Type, then enter these values:
Texture Size
X= 0.1
Y= 0.1
Z= 0.1
Texture Value=0
•Select Use Texture (Transparency Texture panel).

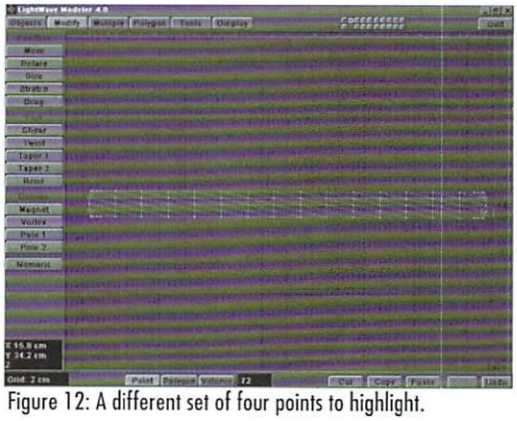
Figure 12: A different set of four points to highlight.

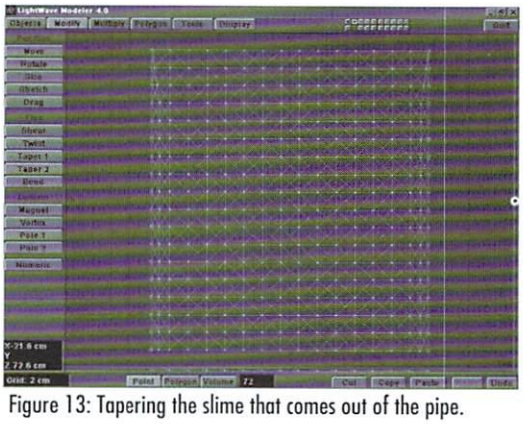
Figure 13: Tapering the slime that comes out of the pipe.

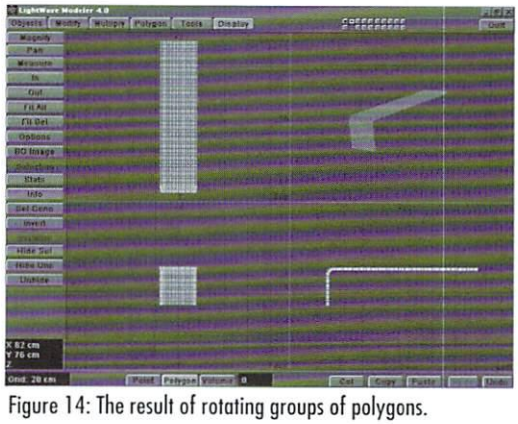
Figure 14: The result of rotating groups of polygons.

This Transparency Map will be used to cast the shadow of a grill over the sewer.

•Select PitWalls as our Current Surface (Surfaces panel) and enter these values:

Diffuse Level= 90
Specular Level= 30

•Select Surface Color (Surfaces panel) and enter these values:

Surface Color
Red= 75
Green= 75
Blue= 75

•Select the T (Texture Map) button beside Surface Color (Surfaces Panel), put Veins as our Texture Type, then enter the following:

Texture Size
X= 0.2
Y= 0.2
Z= 0.2
Texture Color
Red= 55
Green= 55
Blue= 55
Coverage= 0.01
Ledge Level= 0.01
Ledge Width= 0.4
Bump Strength= -0.5

•Select Use Texture (Color Texture panel).
•Select SewagePipe as our Current Surface (Surfaces panel), then under Surface Color enter the following:

Surface Color
Red= 153
Green= 92
Blue= 54

•Click the T (Texture Map) button beside the Diffuse Level (Surfaces panel), select Fractal Noise as our Texture Type, then enter these values:

Texture Size
X= 0.01
Y= 0.01
Z= 0.01
Texture Value 60
Frequencies 5
Contrast 0.3

•Select Use Texture (Diffuse Texture panel) and turn Smoothing on.
•Select SewagePipeEnd as the Current Surface (Surfaces panel) and change the Diffuse Level to 0.

You've finished your objects. Save them so they keep their attributes.
•Go into the Objects panel and save each object over their original version.

A Little Ambiance

All you need to do now is set up your camera and light.

•Turn Trace Shadows on (Camera panel).
•Go back to the main window, click View Camera and Edit Camera (Main Window).
•Select Move (Main Window), click the Numeric button (n) and enter these values:

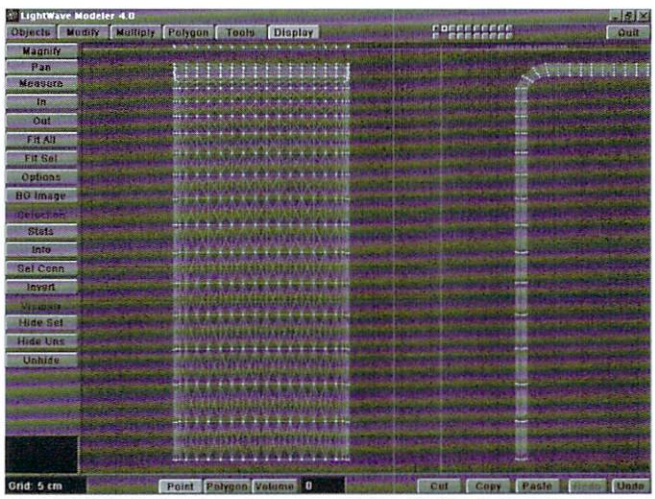

Figure 15 Lengthening the polygons to create acceleration in the surface.

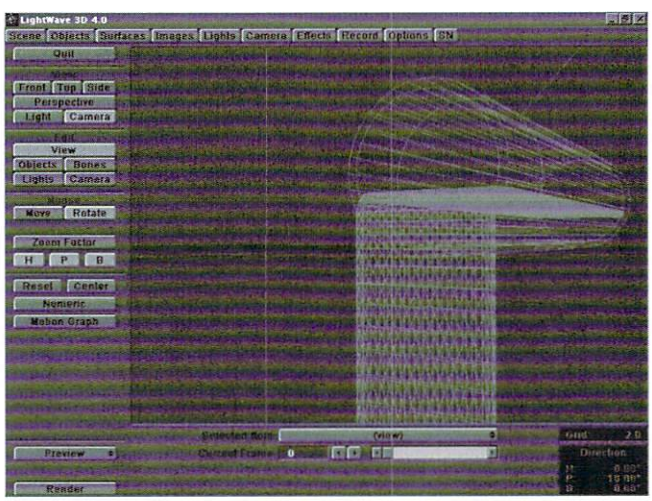

Figure 16: The camera view of our scene.

Camera Position
X= 0.56
Y= 0.26
Z=- 0.36

•Select Rotate (Main Window), click the Numeric button (n) and enter these values:

Camera Direction
Heading= -31
Pitch= -0.3
Bank= 0

•Now create a Key Frame for your camera at frame 0. In the main window either press the (Enter) key twice, or select Create Key (Main Window) and click OK. Figure 16 shows what this view will look like.
•Go to the Lights panel and change the Ambient Intensity (Lights panel) to 25 and the Light Type to Point.
•Go back to Layout's main window, select Edit Light and click on the Numeric button (n). Enter the following:

Light Position
X= 0.92
Y= 3
Z=- 2

•Create a Key Frame for our light at frame 0. In the main window either press the (Enter) key twice, or select Create Key (Main Window) then click OK. Go ahead and save the scene as "Sewer.lws" in the "Sewer" directory.

A Taste Of Things To Come

Finally, the scene is finished. You haven't touched the positions of the objects since they were created in Modeler in their proper positions. If you want to take a peek at what you've created, go into the Camera panel and select Medium Resolution with Antialiasing Off, then press F9 to render a sample image.

To get a good idea of how your slime flows, render a minimum of 90 frames. The pouring effect should be pretty convincing. To make this a little more interesting, add Luminosity to the "Sewage" surface and turn the Glow Effect on (you'll probably have to render a few frames to get the glow settings in the Effects panel right). If you have the time and/or a fast system, remove the Clip Map (Objects panel) for the "Sewage.lwo" object and enter the same values into a Transparency Map (Surfaces panel) for the "Sewage" surface. However, you'll probably have to experiment with the Texture Size, Texture Value, and Contrast values to get the results you want.

This pouring effect can be used in countless circumstances in a variety of ways by simply changing the shape, size, color, transparency, etc. I hope this technique will spark the imagination of at least one person out there. Keep imagining!

LWP

Greg Wilson is the owner of Dayhawk Productions in Sioux City, Iowa. Feel free to contact him by sending a letter to P.O. Box 264, Anthon, Iowa, 51004.

Tree

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tree you are using, but these values seemed to work for the sample tree.

To prevent the displacement map from affecting the branches, give it a falloff of 75% on the y axis, so the ripples will completely die away within 1.3 meters of the top (falloff is measured in percentage per meter). A quick wireframe preview should confirm that the polygons are rippling at the top, quickly dying out as you go lower on the tree. When this is rendered out you should see a slight breeze ruffling the top of the tree.

Now you need to do one more thing to prepare the scene for use. Create another null object and name it MasterTreeNull. Parent your tree object to it. Be sure to constrain its rotation by deselecting it on all three axis from the mouse Rotate function to prevent it from affecting your IK chain. Toggling Unaffected by IK of Descendants from the IK Options panel will accomplish the same purpose.

As a last step, save your scene. Now when you have a outdoor scene that cries out for landscaping, you can use the Load from Scene function (Objects panel) to bring your tree into the scene, complete with IK hierarchy and goal object, so it can be rotated to match the camera angles. By cloning the object and moving it around, you can quickly have an entire forest that will rotate towards the camera based on the movement of the single goal object. Be sure to also clone the Tree Null and reassign each tree's parent as one of the cloned trees.

Because all of the cloned tree objects will be parented to our MasterTreeNull, simply create a key frame for that object and all descendants to match each camera key frame. By using this same procedure for different tree and shrub images, you can have outdoor scenes that will never look bleak and dull again!

Beginner's Notes

- Obtain or prepare tree images for use as color, bump, and clip maps.
- Create a flat polygon to match the tree image
- Create a scene to retain the clip map info, and use IK to keep trees always rotated toward the camera.

LWP

Dan Bloomfield can be reached for comments or questions at 813-821-7002 or e-mail him at dan.bloomfield@mercopus.com

Tip of the Month

Creating A Morph Target Sphere for Intel LW

by Ancel Bhagwandeen

This quick tutorial will show you how to Morph a target sphere from a flat plane using LightWave 4.0. Let's get to it!

1. Create an x-y plane with a 4:3 ratio in dimension (four parts wide, three parts tall), use about 15 segments in the X and y axes and triple the polygons. Name the surface "map-flat". Save the plane as "flat-map.lwo".
2. Center the plane and bend it 360 degrees with a 90 degree direction, + sense (x-axis), forming a cylinder.
3. Center and rotate the plane (now a cylinder) 180 degrees to keep the seam in the back.
4. Select the top half polygons and select Taper 1. Taper in the y-axis, Ease In, + sense, to .001.
5. Select the bottom half cylinder polygons and Taper 1, using the same settings but use - sense. You should have something that looks like a pointy capsule.
6. Use the Spherize macro (Tools|Custom menu).
7. Name this surface "mapsphere", and the sphere as "sphermph.lwo".
8. Merge points and name this surface "spherical", and save this sphere as "realspher.lwo".

In layout, set the flat-map.lwo object as the morph source for the "sphermph.lwo", with an envelope of about 30 frames from 0 to 100%. Then activate Morph Surfaces.

Now, load up a flat image map of the earth (supplied in the Newtek\images\earth dir). Planar map this onto the map-flat surface in the Z directory and select Automatic Sizing. Disable antialiasing. Then, map the same image in the same manner onto the mapsphere surface, but use the x, y, z dimensions from the map-flat surface—do not autosize this. Both surfaces should have smoothing on. Now you can preview the morph. You will probably have to tweak (reduce) the y-size attribute on the sphere's surface for more effective spherical mapping.

It's possible to rotate the "sphermph" object to see the "seam" as a result of the phong shading. This is concealable by direct lighting to prevent the apparent seam shadow. Alternatively, you can dissolve the sphermph object out and the realspher object in (with spherical image mapping), however, you will have to size the planar image map on the "sphermph" object to a near exact match of the spherical image map on the realsphere.

This solution is similar to an Amiga version published by jgjones@usa.net in the LightWave newsgroup (comp.graphics.apps.lightwave), but it works for Intel.

Ancel Bhagwandeen works at Advanced Digital Dreams. Reach him at warp@opus-networx.com.

Editor's Message

continued from page 3

objects polygons. An object is converted to MetaNurbs and back again by simply hitting the Tab key when you have selected a number of polygons. You have to see it to realize how simple it is to create great looking objects quickly.

Layout has some great new additions as well. Among them are the use of multiple textures in the same surface and displacement/clip channels as well as the ability to use Alpha images for textures to create decals on surfaces. Add to that projection images for spotlights, interactive Zoom/Cone angle controls, improved plug-in support and some interface improvements and you get one hell of a nice upgrade. The addition of a lot of cool new plug-ins doesn't hurt either.

One quick note about the shipping 4.0 version of Modeler before I wrap up: There is a patch available on the NewTek BBS and on-line services that will upgrade the Rev C version of Modeler to include proper support for True-Type fonts plus a few bug fixes. Hmmm, maybe you shouldn't bother with the patch—just go to the 5.0 version!

John Gross
Editor

LWP

3D to 2D

Get the "Cel-Look" with LightWave

by Stephen Bailey

I've recently considered methods for achieving a 2D or cel-look using LightWave 3D and 3D character geometry. The task involves trying to understand which 3D aspects to retain and which to discard with regards to color and shading of the character. I am by no means an expert on ink-and-paint, the process by which hand-drawn cels are outlined and colored. My aesthetic model (herein called the model) consists of a video copy of the Japanese Anime masterpiece, *Akira* (dubbed in English, no less) and some childhood memories of *Johnny Quest*. My hope is that others will take a stab at this process, given the results present an interesting aesthetic option for LightWave character animators.

Cel-animation as a medium encompasses a variety of styles of action and storytelling, many of which are perhaps poorly suited for 3D embellishment. There is no one aesthetic that represents the *cel-look*. Behind every animation style is an animator with a point of view and tools to express it. Here, I intend to discuss basic shading methods and ideas for further inquiry. Your results will vary (in hopefully useful directions) based on a number of criteria outside the realms of surfacing and lighting. Until I apply the effect to moving geometry, for instance, I can only speculate on the final results.

Analyzing the Goal

Achieving a basic cel-look involves a set of selective degradation processes. We are trying to either minimize or specifically define the shading applied to 3D geometry, delineating shadow and highlight areas as discreet arrangements that imply hand-drawings. We will employ features in the Objects, Surfaces, and Lights Panels in Layout to pseudo-paint selected areas of the geometry, rather than applying a blanket filter to the final render. What is needed out of the render and what needs to be removed? I've found three main areas of productive concentration: adjusted shadow handling, selective deemphasis of specular properties, and successful implementation of the new Cel-Edge option for LightWave 4.0 users.

After staring at still video frames from *Akira*, I began to notice a specific coloring and shading

Figure 1: The Beethoven model under default lighting.

motif. Shadow areas are rarely black, unless the setting is a noirish alleyway or some such locale. Instead, they are shaded with the same pigment, only at a lower intensity level. A light blue business jacket, for instance, has shadow areas and folds shaded as a darker blue. Flesh coloring seems to be handled similarly. These shapes are very organic. Shading the hair and face of a human character will prove to be the major challenges for this technique.

The Basic Settings

There are a few direct Surfaces Panel settings we can apply across all cel-like surfaces. Luminosity is set high, around 100%, so that shadow areas lighten. Diffuse Level should also be set at 100% to offset diminished shadow values caused by high Luminosity. The shadow terminator of these characters, or the thin gradient between shadow and non-shadow, is almost always a hair-thin line rather than a fuzzy gradient, therefore, the Sharp Terminator toggle should be clicked on for all cel-like surfaces, and Smoothing should be enabled. Specularity can be left at 0%. Later, I'll discuss using this section of the Surfaces Panel to augment shiny surfaces.

In the Lights Panel, raise the Ambient Intensity to 80%, and set your Shadow Type to Raytrace shadow-casting lights. This will create hard-edged shadows, augmenting the effect of enabling Sharp Terminator in the Surfaces Panel. It's a good idea to start with one shadow-casting Distant light when defining the initial shading settings. Remember to also enable Trace Shadows in the Camera Panel. The combination of a high Ambient Intensity and high Luminosity forces the shadow areas to lighten, while high Diffuse Level settings maintain the shadows remnant (increase this value for greater shadow presence). The shape and continuity of the shadow is more rigid. We basically cause secondary pools in shadows to blow out, accentuating the primary shaded areas.

The finishing touch comes from a new feature in LightWave 4.0: Cel-Edges. It is currently an experimental feature. To enable it, first type Ctrl-Shift-F1 while looking at the Layout window. Click Continue. Then, go to the Objects Panel and, selecting the object to which you wish to apply cel-edges, type Ctrl-Shift-F3 and Continue. You'll notice that Polygon Edges have become enabled. You can adjust the heaviness of your "ink" by toggling the Particle/Line Size settings. Usually, you'll want to leave the Edge Color at its default settings (black).

This feature operates in conjunction with the geometry of your model. It defines ink lines by both the outline of the entire object and the outline created by surface borders. It's effects can be desirable or undesirable. LightWave can decide on some strange inking ideas with extremely organic geometry. Objects should be modeled and tested with the

Figure 2: Application of Cel-Edges with initial surface and lighting settings.

feature in order to achieve the desired outlined-look. For rendering, setting the Polygon/Line size to Small and using Low antialiasing gives good results. Larger settings give the impression of a wide flair-tip, and can be useful for low-light, low-contrast

scenes. Thin, sharp lines are the most desirable—they more closely mimic my 2D model under high-key lighting

Some Examples

I have taken the model of Beethoven's bust, provided in the demo material on the LightWave CD-ROM, and applied the basic settings discussed above. For all illustrations, Camera Panel settings include: Ray-Traced Shadows, Square Pixels, 1020X768 at Low Antialiasing with Adaptive Sampling enabled at the default 8 threshold. All other settings remain off or at default. Figure 1 shows a default view of the Beethoven object prior to surfacing. Here, we notice how detailed shading provides cues that imply dimensionality to the viewer. Figure 2 shows the initial effect of applying our settings. The lighter background color (Effects Panel) helps to suggest a paper medium (more on this later). Shadow areas are obvious, though much fainter. Notice how their shapes are less busy, less spread across the geometry. They have rendered as more discreet and contained areas. The cel-edges are thin and seem imperfect, which is fine for our purposes. Remember, strategically placed flaws can enhance the hand-rendered impression of the image.

Figure 3: Pigment helps quite a bit.

The eyebrows are outlined. Aspects of the eyes and mouth, as well as the clothing, are equally defined. We see how the "inking" is determined by surfacing information as well as geometry. Again, modeling can have a profound impact on the success of this technique. The inking on the hair is, well, mysterious. In the still, it seems acceptable. A motion render will provide evidence of success or failure here. I've tried using a hair generator and have found it to be a very dimensional addition with which I'm not fully pleased, though I can imagine a nice five-o'clock shadow coming out of a dense application of single-line (2-point) polygons. Remember, you can toggle Polygon/Line Size with Polygon Edges enabled (Objects Panel) to adjust for dense or sparse areas when trying this.

Figure 3 is an example of final coloring for our Beethoven model. The way in which shadows take on the hue of their hosts' surface colors mimics shadows in cel-animation very well. Gradual, soft shading in the hair is a problem, however. Tweaking the Luminosity variable higher may give better results. The eyebrows, when colored with a dark pigment, lose the outlined appearance they had in Figure 2 due to their surface color blending closely with that of the cel-edge line.

In *Akira*, the specular properties of most surfaces are minimized except for instances where explicit metal, hair, or glass is necessary. The areas that imply shininess often appear as organic shapes or waves of specularity, versus the very particular elliptical hotspot that characterizes unmodified specularity in LightWave. In this instance, I suggest the use of a customized Specular Image Map to shape the hotspot to our needs. Hair is another interesting issue. The hair highlights in the film are brightly pointed hand-drawn shapes that break up the hair's figure. Specularity is needed on the 3D equivalent, but it should be broken-up in such a way as to mimic the hand-drawn model. A Specular Image Map would help here, as well. I get good results using a wavy pattern that's tileable. Photoshop works well in this instance. Dpaint, Brilliance, ToasterPaint, or any paint program that can save a HIIP-supported image format should also do the trick.

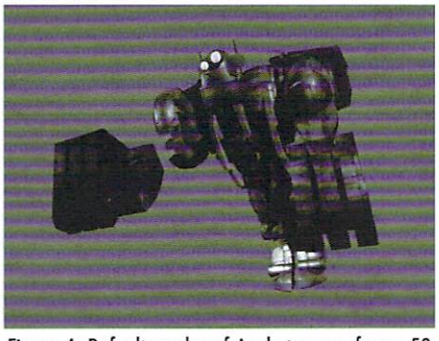

Figure 4: Default render of Apebot scene, frame 50 (aber_52.lws).

Figure 4 is a frame from one of the ApeBot scenes on the LightWave CD-ROM (ABER_52.LWS). Figure 5 is the same frame with the cel-look settings applied. I enabled the Glow Effect for the robot's eye-glass surface while activating the main Glow Effect toggle in the Effects Panel. The settings were left at their defaults. I also added a spot-light cone object emanating from the eye to mimic the light-beam's passage through air. I simply parented it to the ApeBot's cranial object and gave it an initial keyframe protruding from the eye-lens. This object is also on the LightWave CD.

A custom image map was used to affect specularity. The white pattern on the blue fingers of the ApeBot is an example of this map at work. Glossiness is set at Low to give a broad area of coverage in which the map can operate. Adjust the map and you adjust the shape/coverage of those hotspots. Depending on your map, the size settings in the Specular Image Texture Map Panel will have to be changed. For instance, my useful size settings float around 15, 15, 15, meaning I probably have too much small detail in the map that isn't fully communicated in the render. I have the option of sizing it down a bit and defining further the shape of the specularity. Again, this is a matter for continued experimentation.

Suggestions

Earlier, I mentioned using a white or lighter muted background color in the scene (Effects Panel) to imply that we're drawing on paper. I like this idea because it definitely "sells the look." Advancing this motif, one could employ a Diffusion Texture Image Map on all the surfaces. There's a Diffusion Map in use on the ApeBot surfaces in Figure 5. It is easily generated in Photoshop using the noise filter on a white background. The speckled contrast level is very low (faint pixels) in the map and gives just a hint of paper to the surface. I'm sure a fractal noise procedural texture, or a scan of crumpled paper, could be set to do a similar job. Automatic Sizing in the Surface Texture Panel will properly position the image map. Also, consider the increased effect of punctuated maps with more contrast. Applying a large background image in the same motif might give you a more unmistakably "paper" effect. And, if your background image has ruled lines in it (i.e. to mimic notebook paper), you could apply it in conjunction with a Front Projected Diffuse Level Texture map of the same image on all cel surfaces (adjusting Surface Color to match the background paper hue), a la Stick-Figure Theater.

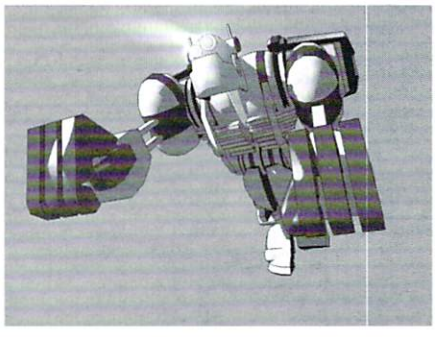

Figure 5: Same as Figure 4 with cel-animation settings fully applied.

As this article goes to press, a variety of surface shader plug-ins may be available (or coming soon) for achieving variations on the cel-aesthetic I'm outlining here. Having seen demos of a couple of cel-shader implementations, I can't wait to start playing with the release versions. Hopefully, this technique will provide those of us looking for a cel-animation look with some fruitful shading strategies while those plug-ins journey toward the marketplace.

Happy Tweak-fest.

LWP

Stephen Bailey is a Senior Computer Animator at Will Vinton Studios. Email to sbailey@vinton.com.

Tread On Me

Leave Your Mark With These Animated Tracks

by Adrian Onsen

A while back, I read Joe Angell's article "Making Tracks" (Nov. 1995 *LIGHTWAVEPRO)* on how to create moving tank treads. It was a great tutorial, but it left me wondering how I could make the actual impressions in the ground as the vehicle moves by. That's where this article comes in. You can use this effect for cars, tanks, or any other land vehicle that leaves impressions of its tires or tracks behind as it moves.

Creating the Objects

Let's start with creating the actual tire. First you'll need to know what a tire looks like in profile in order to create it. Figure 1 has my interpretation of a simple tire, but you can get more technical if you want. For now, draw something simple—the purpose of the tutorial is to make tracks, not tires!

•Go into Modeler and use the Sketch tool (Objects) to draw the outline of the tire in the Z-Y view. It should look something like an upside-down U shape (Figure 1). To get a nice large view, zoom in with the (.) key until your grid is 50 mm. Make sure the sketch is around 250 mm tall. Hit Enter when you're done sketching.

•Now you can more accurately arrange your points in order to create the look you want. (For this tutorial, try to stick to the values mentioned as closely as possible: Around 250 mm tall and 300 mm wide.) Once you're satisfied with the basic shape of the tire, you can position the outline into place.

•Position your shape in the X-Y view by pressing (t) and moving the outline around. I've placed mine 65 cm from the axis to the outermost point on the outline. If you've zoomed in, zoom out (,) until you can see the X axis. You need to have the outline exactly on the Y-axis . To do this, go to the Tools menu, and select Set Val. Click the X axis, and make sure you have 0 in for the Value. Select OK.

•Copy this shape and Paste it into Layer 2 (2), then go back to Layer 1 (1).

•Now you need to Lathe (Multiply) the outline about the Z axis with a center at 0, 0, 0. Access the panel by pressing (n). Increase the number of sides if you want a smoother looking surface, but this will increase the polygon count by quite a bit. For our purposes here, leave it at 16, and click OK. Then press Enter.

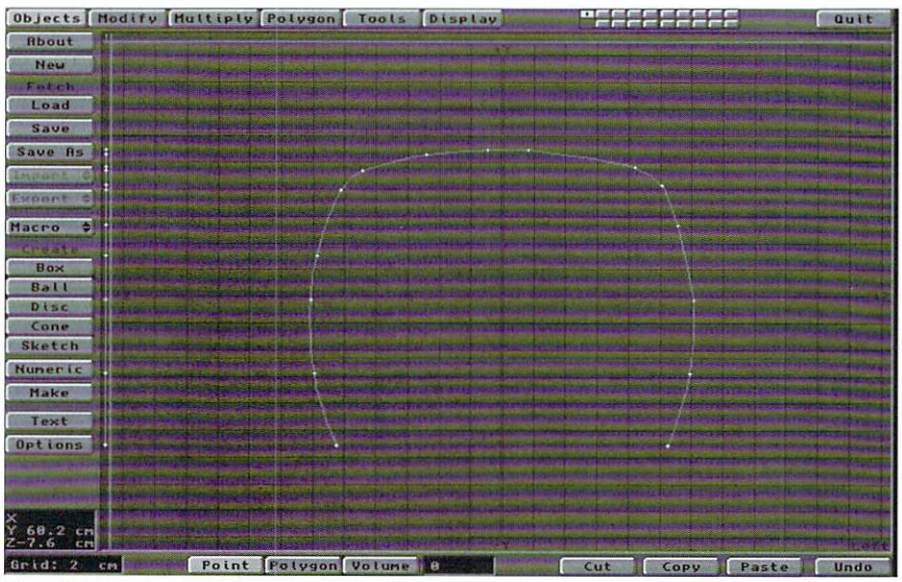

Figure 1: The outline of the tire.

•Hit (a) to Fill All, and you should now have a pretty nice looking tire on your screen (Figure 2). You now want to make sure that all the polygons are facing outward, so select a few polygons and see which way they are facing (which way the dotted line points). If they are pointing inward, unselect the selected polygons and hit (f) to Flip all polygons.

•It's time to assign a surface to the tire. Hit (q) to bring up the Surface requester in the Polygon menu and change the default to 'tire-surf'. Now save the object as 'tire.lwo'.

Our new tire is fine and dandy, but it won't leave the depression behind it just by rolling it around! Now we have to create the actual depression made by the wheel as it rotates over a surface, and have the depression appear behind the tire as it moves. The trick to this effect is knowing the path the wheel will take before you can create the depression.

Element Two: The Ground

•In Modeler, go to the 3rd Layer (3) and create a plane by clicking the Box button (Objects), then press (n) to bring up the numeric requester. Define the plane in meters with the following dimensions, then click OK followed by Enter:

Low
X= -7
Y= 0
Z= 3
High
X= 2
Y= 0
Z= 3
Segments
X= 1
Y= 1
Z= 1

•Hit (a) so you can see the entire plane on your screen.

•Now move the plane in the Y direction -60 cm by

hitting (t), then (n) For a Y value, enter -60 cm and leave zeros for X and Z, then click OK.

•Now you have a surface to work on, so gauge out the area that will be depressed by the tire as it moves. To do this, go to Layer 2 (2) where you copied the outline of the tire, and Rotate (Modify) it about the Z axis by 180 degrees. Enter 180 degrees about the Z-axis with a center at 0, 0, 0, and click OK. Copy it into Layer 4 (4).

•Now draw out the path you want the tire to travel. Keep it simple and just make it a straight line. Then go to Layer 5 (5) and in the Polygon menu, select Points and press (n). As a point, enter 0, 0, 0 and click OK. Then hit (enter) to place the point. Hit (n) again and add another point at -5m, 0m, 0m. Then click OK to place the second point.

•You should how have 2 points on the screen. Connect them by going to the Tools menu and clicking Make in the Curves section. This will make a single sided polygon between the two points. Use this as your path in order to Rail Extrude the shape of the tire.

•Go to Layer 4 (4). You should have the outline of the tire as a curve (not single sided polygons). In the Tools menu, hit Freeze. This will take the curve and make it into a polygon.

•In Layer 4 (4) where you have the tire polygon, put Layer 5 (Alt 5) in the background. Go to the Multiply menu and select Rail Ext, then click OK. This should create a 5 piece object in the center of your screen. Now find out which way the polygons are facing. You want them to face inward, so if they face the wrong way, unselect what you just selected and hit (f) to flip all polygons.

•Hit (q) to assign a surface to the new object, name it 'ground-groove' and click Apply.

•To actually cut this out of the plane, use the Boolean function. First have Layer 3 (3) in the foreground and Layer 4 (Alt 4) in the background. Select the Boolean tool in the Tools menu, then select Subtract and press OK.

•Next you need to flip all the polygons, so flip them up by pressing (f).

•Select only the ground plane polygon (not the actual polygons making the groove) and hit (q) to assign a surface name to the plane. Call it 'ground-plane'.

•Save the object in Layer 3 as 'ground-plane.lwo'

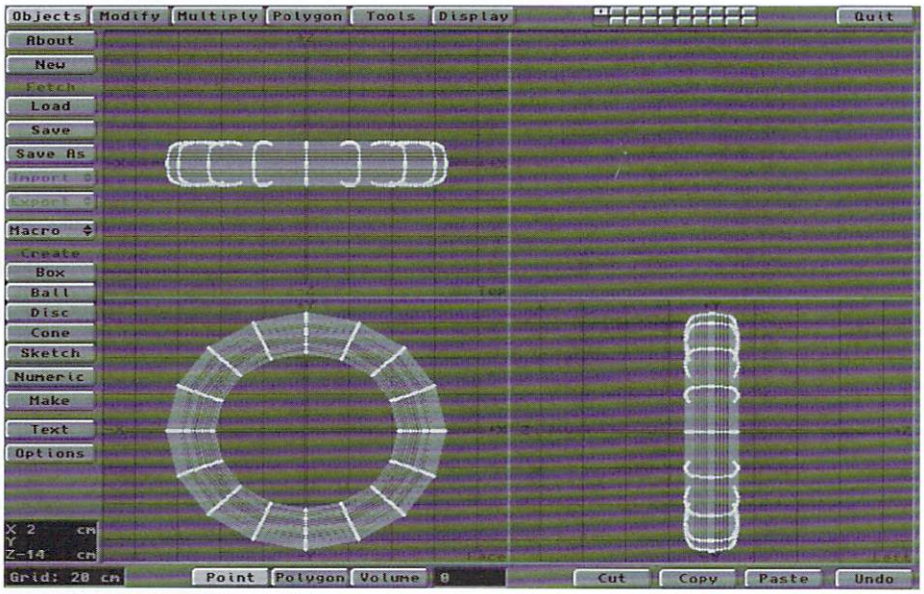

Figure 2: The result of the Lathe operation.

The only thing to do now is to create another plane to cover up the groove, which we'll make disappear gradually in Layout.

•Go to Layer 6 (6) with Layer 3 (Alt 3) in the background, and select the Box tool (Objects). Now draw another smaller plane, covering the part that we cut out of the ground plane. Make it the following dimensions, and click OK:

Low
X= -0.250 m
Y= 0
Z= -0.3 m
High
X= 5.25 m
Y= 0
Z= 0.3 m
Segments
X= 1
Y= 1
Z= 1

•If .3 m isn't enough to cover the width of the tire groove, you might want to increase that to suit your situation.

•Now hit Enter to place the plane.

•Since this plane's polygon is facing downward, Flip (f) it upwards.

•Hit (q) to assign a surface name to the new object. You want to call the surface the same name as the ground plane, so click the box with the words "Default" and select the surface 'ground-cover', then click Apply.

•Save this object as 'ground-plane-cover.lwo'. Our work is done in Modeler, so let's go to Layout.

The way to pull this trick off is to uncover the groove you've made as the wheel moves, and create the illusion of the wheel actually making an indentation. You can accomplish this in two ways. By using a Clip Map, you can make an animated sequence where the screen starts off black, and with time gradually cover more and more of the screen with the color white, starting on the left side so the animation looks like a wipe from left to right. The other method is much simpler and works just as well. Just shrink the cover plane from one end over time, so it will appear as if it is vanishing. I mentioned the Clip Map method because the method of shrinking the plane won't work if you have a curved path to travel.

•In layout, load the objects you created in Modeler; 'tire.lwo', 'ground-plane.lwo' and 'ground-plane-cover.lwo'.

•Go to the Surface menu and select the 'tire-surf' surface and set the following:

Surface Color	40, 40, 40
Luminosity	20%
Diffuse Level	50%
Specular Level	10%
Glossiness	Low
Smoothing	On
Double Sided	On

This will make the tire look somewhat realistic. For added realism, you can add a few image maps to the tire.

•Surface the 'ground-plane':

Surface Color	60 100 0
Surface Texture	
Texture Type	Fractal Noise
Texture Size	1.5 (for X)
	1.0 (for Y and Z)
Texture Color	120 50 0
Frequency	3
Contrast	1.0
Luminosity	20%
Diffuse Level	50%

This is going to put patches of green and brown over your ground plane. Again, here's where you can get creative and put whatever texture you want over the ground plane. Use the same settings for the 'ground-cover' surface with one exception; In the Texture menu, select World Coordinates. You need to have World Coordinates turned on, because as the covering plane shrinks, you don't want the texture to shrink with the plane. This will prevent that.

•Finally, surface the 'ground-groove':

Surface Color	120 50 0
Luminosity	50%
Diffuse Level	50%
Smoothing	On

•Most of the objects are already set up in the scene. You only need to move a few things. Start with the 'ground-cover' object. Enter the following values for X, Y and Z: -5.25, -0.595, 0. If you remember back in Modeler, we offset the ground plane by 60 cm. Here, you're placing the covering only 5 mm above the ground, so you can't see the difference. If you place it on the same level with the ground plane, you're probably going to get rendering errors. Hit Create Key for all objects.

•Go to frame 30 and change the size in the X direction only of the 'ground-cover'. Stretch it on the X axis to 0.045 and leave the rest to 1.0. Click Create Key.

•Next Move the tire.lwo object -5.0 in the X direction, and 0 in the Y and Z directions. Click Rotate, then hit (n) and enter 440 degrees in the Bank requester so the tire will spin rather than drag along. Hit Create Key.

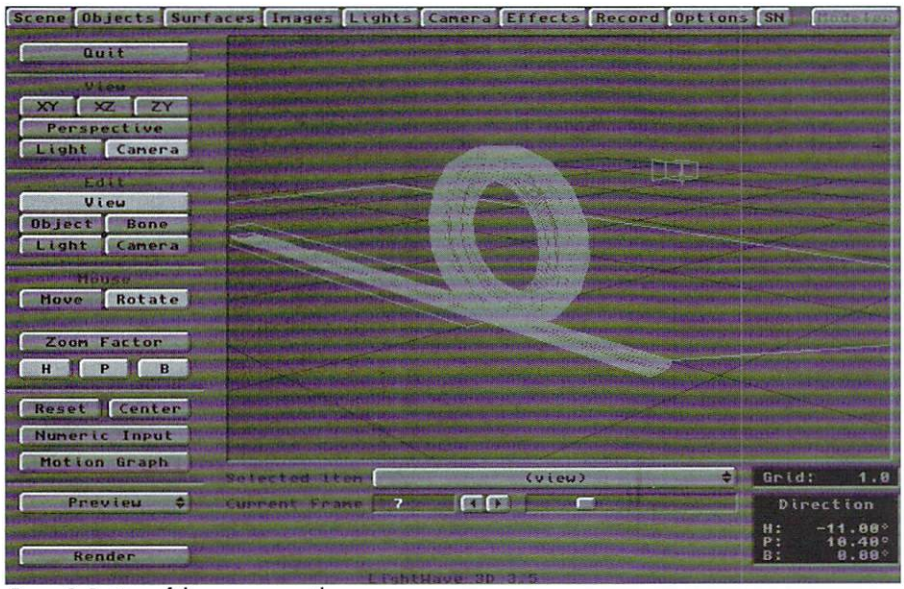

Figure 3: Position of the camera over the scene.

Well, that's it! You've done it! All you have to do now is render the 30 frames, and watch the wheel make an impression on the ground behind it. Like I said earlier, this can be used for more than just a car tire. For example, you can probably use this technique to create footsteps in snow with a few modifications, but that's a different tutorial!

LWP

Adrian Onsen is an Aerospace Engineering student at Ryerson Polytechnic University in Toronto. In his spare time he tries to make a buck animating with LightWave. Reach him at aonsen@ryerson.ca, or you can visit his home page at http://www.ryerson.ca/~aonsen. Hope to hear from you!

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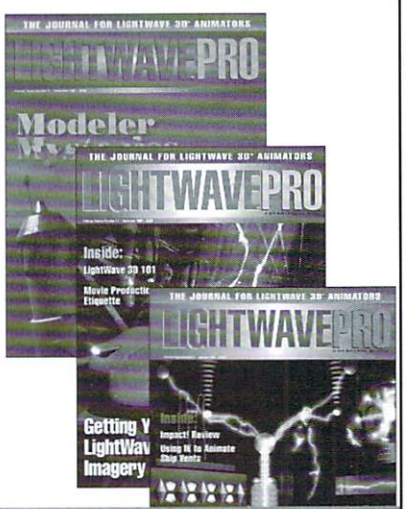

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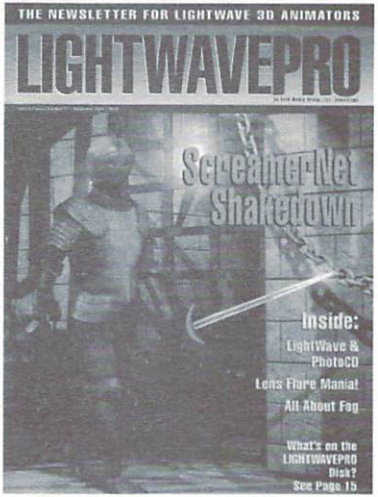

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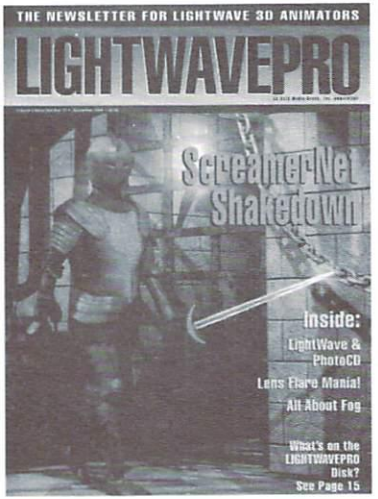

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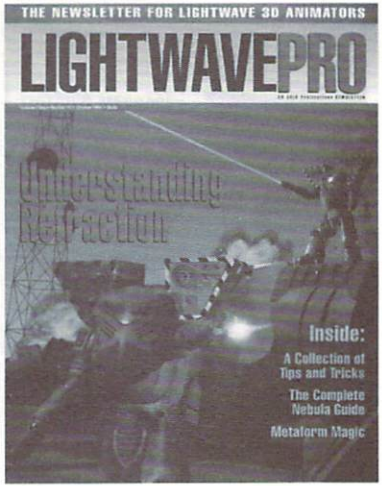

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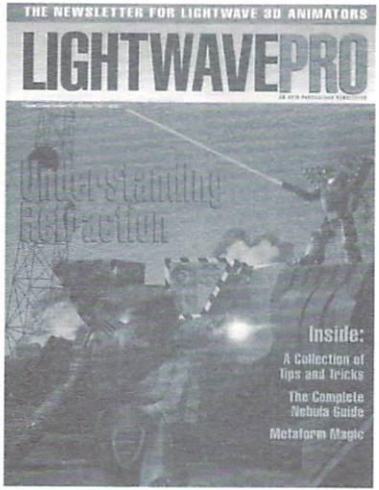

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